ELIZADE UNIVERSITY, ILARA-MOKIN
FACULTY OF ENGINEERING
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING
FIRST SEMESTER 2020/2021 SESSION

Course Title: FLUID MECHANICS. **Course Code:** CVE 309 **UNITS:** 2

INSTRUCTION: **Attempt any FOUR Questions** and find the figures within the body of questions on the last page. Time allowed: 2^1/2-hrs

HOD'S SIGNATURE

QUSETION ONE (15 Marks)

1a. With a velocity of 0.36m/s, a plate with an area of 0.6m2 slides down an inclined plane at 30 degrees to the horizontal. Between the plane and the plate is a 1.8 mm thick fluid cushion. If the weight of the plate is 300N, measure the viscosity of the fluid. **(6 Marks)**

1b. Derive Bernoulli's Equation **(6 Marks)**

1c. Define the following (i) Meta-center (ii) Meta-centric Height iii Centre of buoyancy **(3 Marks)**

QUESTION TWO (15 Marks)

2a. Describe dimensional homogeneity and itemize its applications (3) **(3 Marks)**

2b. The velocity distribution for flow over a plate is given by $u = \frac{(2y-y^4)}{Y^2}$ where u is the velocity in m/s at a distance y meters above the plate. Determine the velocity gradient and shear stress at the boundary and 1.5 m from it. **(5 Marks)**

2c. What.do you mean by fundamental units and derived units? Give examples **(2 Marks)**

2d. The diameters of ram and plunger of an hydraulic press shown in **FIGURE 2D** are 600 mm and 30 mm respectively. Find the weight lifted by the hydraulic press when the force applied at the plunger is $400N$. **(5 Marks)**

QUESTION THREE (15 Marks)

3a. Determine the dimensional analysis of the following: a. Specific Weight b. Discharge **(5 Marks)**

3b. Itemize and explain in detail the types of equilibrium of a floating body **(4 Marks)**

3c. A pipe **(FIGURE 3C)** $200m$ long slopes down at 1 in 100 and tapers from $600mm$ diameter at the higher end to $300mm$ diameter at lower end, and carries $100liter/sec$ of oil (sp. Gravity 0.8). if the pressure gauge at higher end reads $60kn/m^2$, determine: (i) velocities at the two ends (ii) pressure at the two ends. Neglect all loses. **(6 Marks)**

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QUESTION FOUR (15 Marks)

4a. With the aid of a suitable diagram show the different conditions that governs the principle of buoyancy. **(4 Marks)**

4b. A floating in water wooden block with a specific gravity of 0.7 and dimensions of 2m x 0.5m x 0.25m. Determine the volume of concrete with a specific weight of 25kn/m3 that can be used to fully submerge (i) the block in water and (ii) the block and concrete in water.

(6 Marks)

4c. For an underwater building project, a crane is used to lower weights into the sea (density =1025 kg/m3), as shown in **FIGURE 4C**. Determine the stress in a crane's rope caused by a rectangular 0.4 m x 0.4 m x 3- m concrete block (density = 2300 kg/m3) suspended in the air and fully submerged in water. **(5 Marks)**

QESTION FIVE (15 Marks)

5a. State the differences between liquid and gases **(3 Marks)**

5b. Calculate the specific weight, density and specific gravity of one liter of a liquid which weighs $7\ N$. **(5 Marks)**

5c. Using Buckingham's pie-theorem, show that the velocity through a circular orifice is given by **(7 Marks)**

$$V = \sqrt{2gH}\phi\left[\frac{D}{H}, \frac{\mu}{\rho VH}\right]$$

Where, $H = Head\ causing\ flow$

$\mu = Co - efficient\ of\ viscosity,$

$g = Acceleration\ due\ to\ gravity$

$D = Diameter\ of\ the\ orifice\ and$

$\rho = mass\ density$

QESTION SIX (15 Marks)

6a. A partially submerged body is towed in water. The resistance R to its motion depends on the density ρ, the viscosity μ of water, length l of the body, velocity v of the body and acceleration due to gravity g. Show that the resistance to motion can be expressed in the form.

$$R = \rho L^2 V^2\left[\left(\frac{\mu}{\rho LV}\right).\left(\frac{Lg}{V^2}\right)\right]$$

(8 Marks)

6b. A pipeline **(FIGURE 6B)** is 15cm in diameter and it is at an elevation of 100m at section A. At section B it is an elevation of 107m and has diameter of 30cm. Pressure at A is 35kpa as 60 liters

of water per second are discharged into this pipeline. If the flow is from A to B, as shown in Figure 6, measure the pressure at B.

(7 Marks)

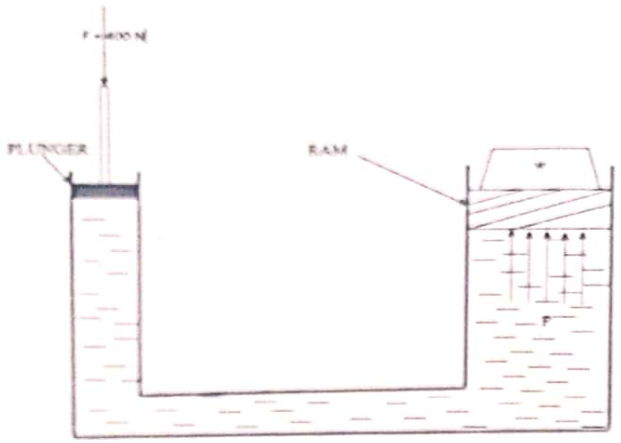

FIGURE 2D: HYDRAULIC PRESS

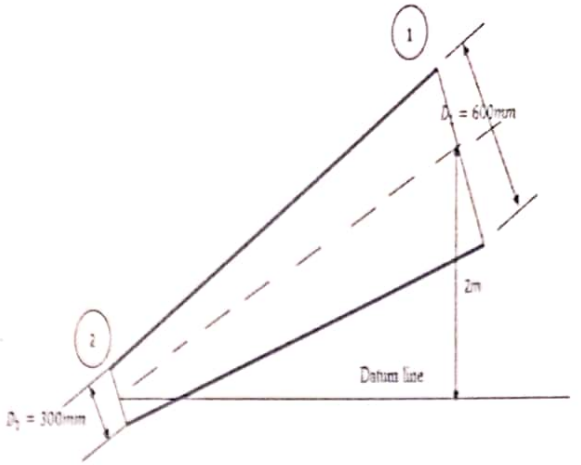

FIGURE 3C: PIPE CHANNEL

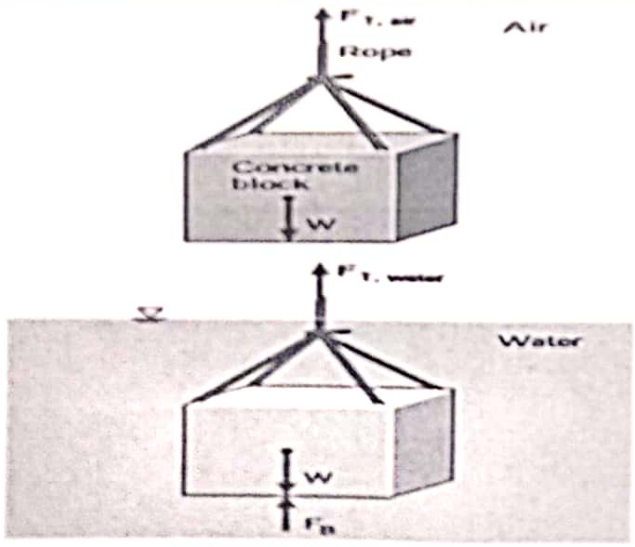

FIGURE 4C: CRANE

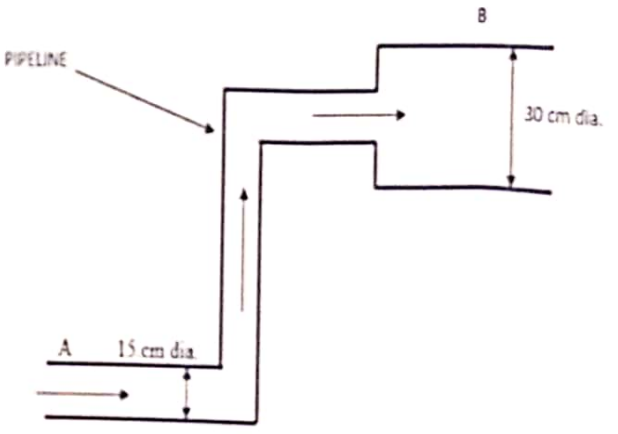

FIGURE 6B: PIPE NETWORKS